Foundation Initiative 2010

Establishing the Foundation for DoD Range Interoperability

Capability/Business Opportunity Brief

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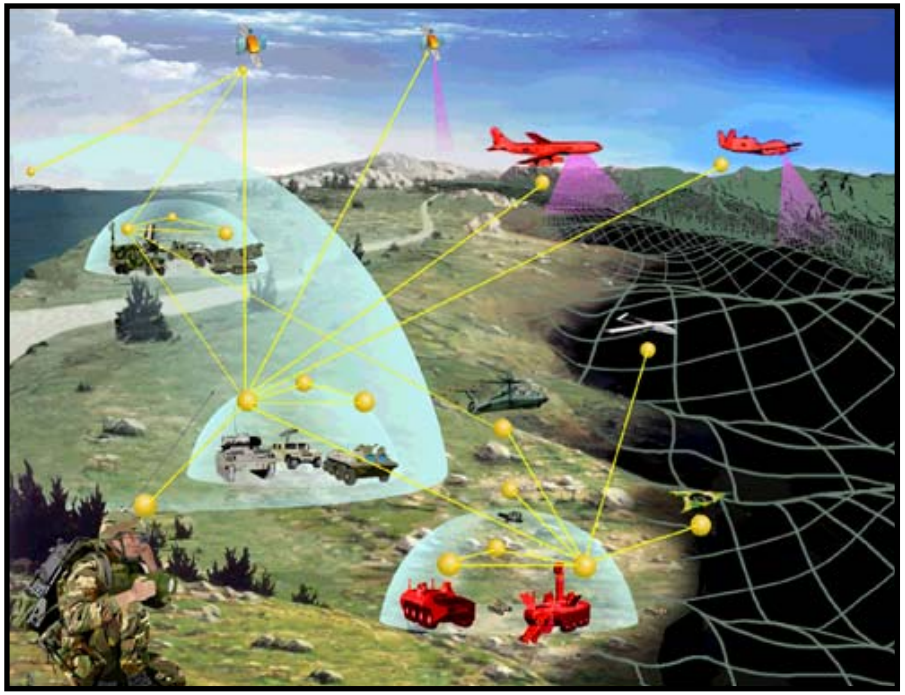
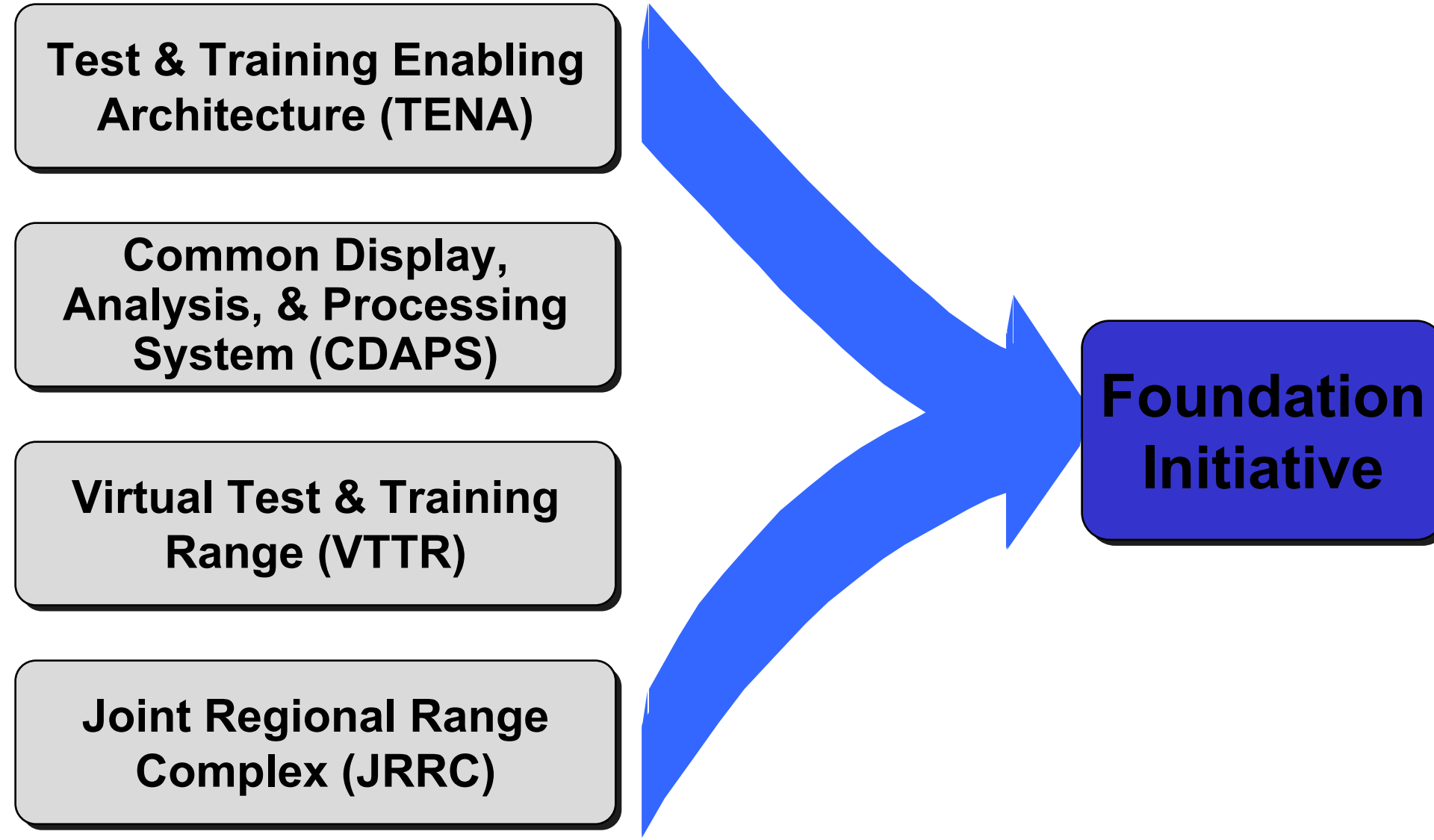
Vision

- **Design and prototype a technological infrastructure to enable interoperability and reuse within the range community.**
  - Improve the scope and scale of testing and training.
- **We need to:**
  - Satisfy the core operational and performance requirements
  - Work with the range community so solutions are implemented
- **Lay the groundwork for full lifecycle support.**



Consolidation of Four CTEIP Projects into FI 2010



Funding/Scope Background

- **Funding Revisions**
  - **FY98 Mid-year $109.2M**
  - **FY99 Mid-year $ 72.7M**
  - **FY00 Mid-year $ 39.8M**
  - **FY01-present $ 40.0M**
- **FY98 funds: Summary of TENA, CDAPS, VTTR & JRRC**
- **FY99 Scope Re-definition (subsequent to Mid-year)**
  - **Direction to re-size project to accomplish critical tasks for real-time interoperability (project scoped at ~$40M)**
  - **Focus on integration of tools vice development of new tools.**
- **FY00 De-Scope and Re-definition**
  - **New baseline established to accomplish critical tasks for real-time interoperability**
- **FY 04 Last Year of Current Development supported by OSD**
- **FI 2010 is Transitioning to Sustainment from now through FY 05**

Driving Technical Requirements

1. **Interoperability**
   - The characteristic of a suite of independently-developed components, applications, or systems that implies that they can work together, as part of some business process, to achieve the goals defined by a user or users.

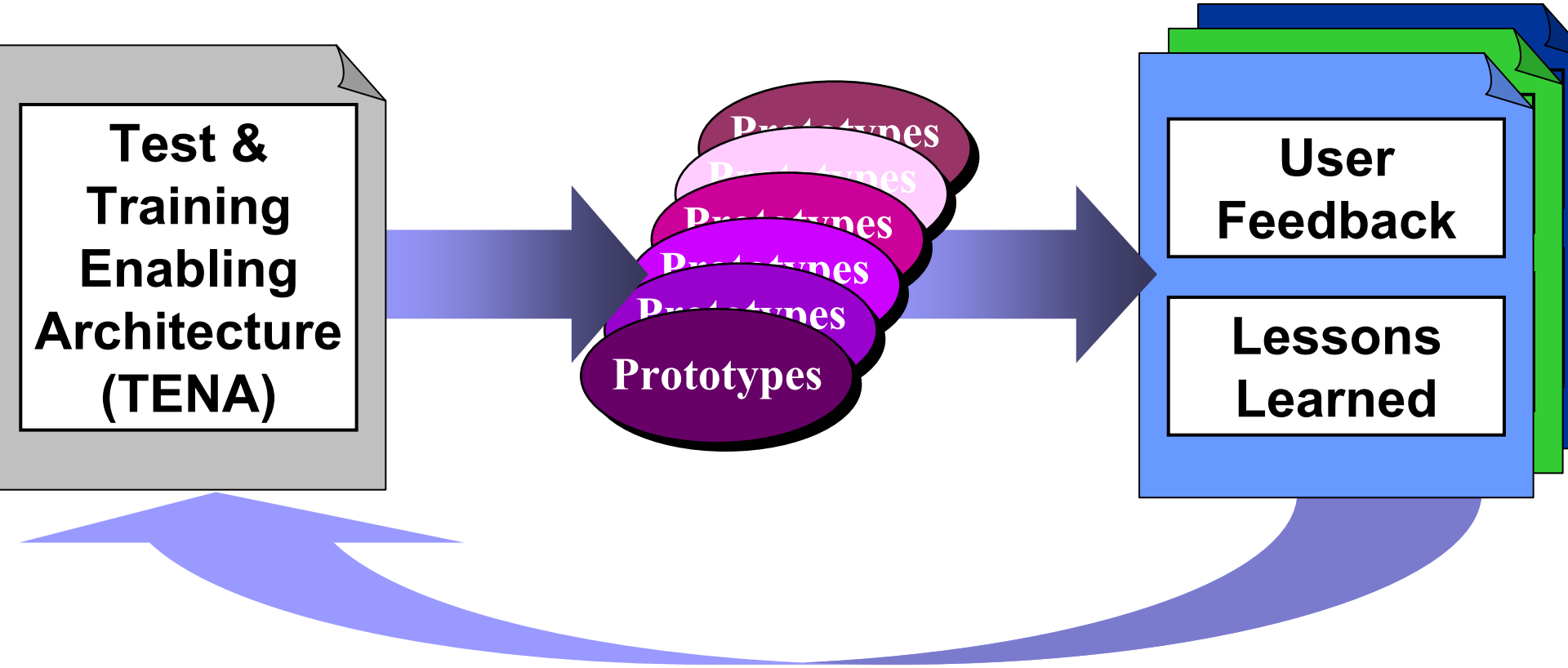
2. **Reusability**
   - The characteristic of a given component, application, or system that implies that it can be used in arrangements, configurations, or in system-of-systems beyond those for which it was originally designed.

3. **Composability**
   - The ability to rapidly assemble, initialize, test, and execute a system from members of a pool of reusable, interoperable elements.
   - Composability can occur at any scale — reusable components can be combined to create an application, reusable applications can be combined to create a system, and reusable systems can be combined to create a system-of-systems.

Achieving Interoperability, Reusability, and Composability

- **Interoperability requires:**
  - A common architecture → **TENA**
  - An ability to meaningfully communicate
    - A common language → **TENA Object Model (OM)**
    - A common communication mechanism → **TENA Middleware**
    - A physical connection between the two systems → **Network, shared memory**
  - A common context
    - A common understanding of the environment → **TENA Object Model (Environment)**
    - A common understanding of time → **TENA OM, TENA Middlewar**
    - A common technical process → **TENA Technical Process**
- **Reusability and Composability require the above, plus**
  - Well defined interfaces and functionality for the application to be reused → **Reusable Tools, Repository**

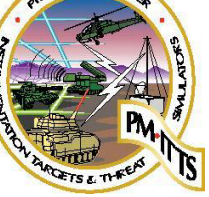
Overall Development Strategy

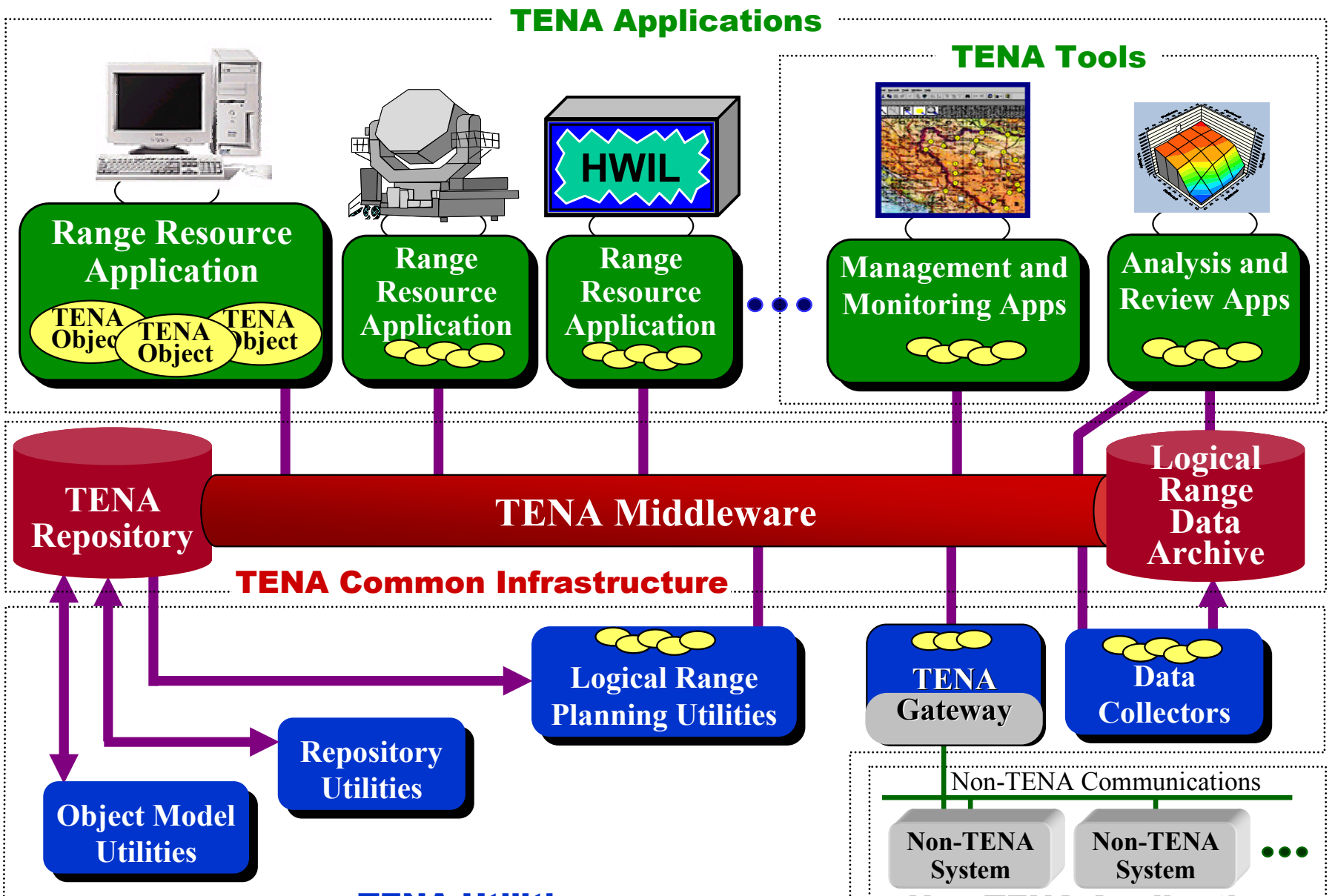


- TENA was revised based on user feedback and lessons learned from working software prototypes
- TENA will be revised in the future based on future prototypes

TENA is based on real-world tests at real ranges

TENA Architecture Overview



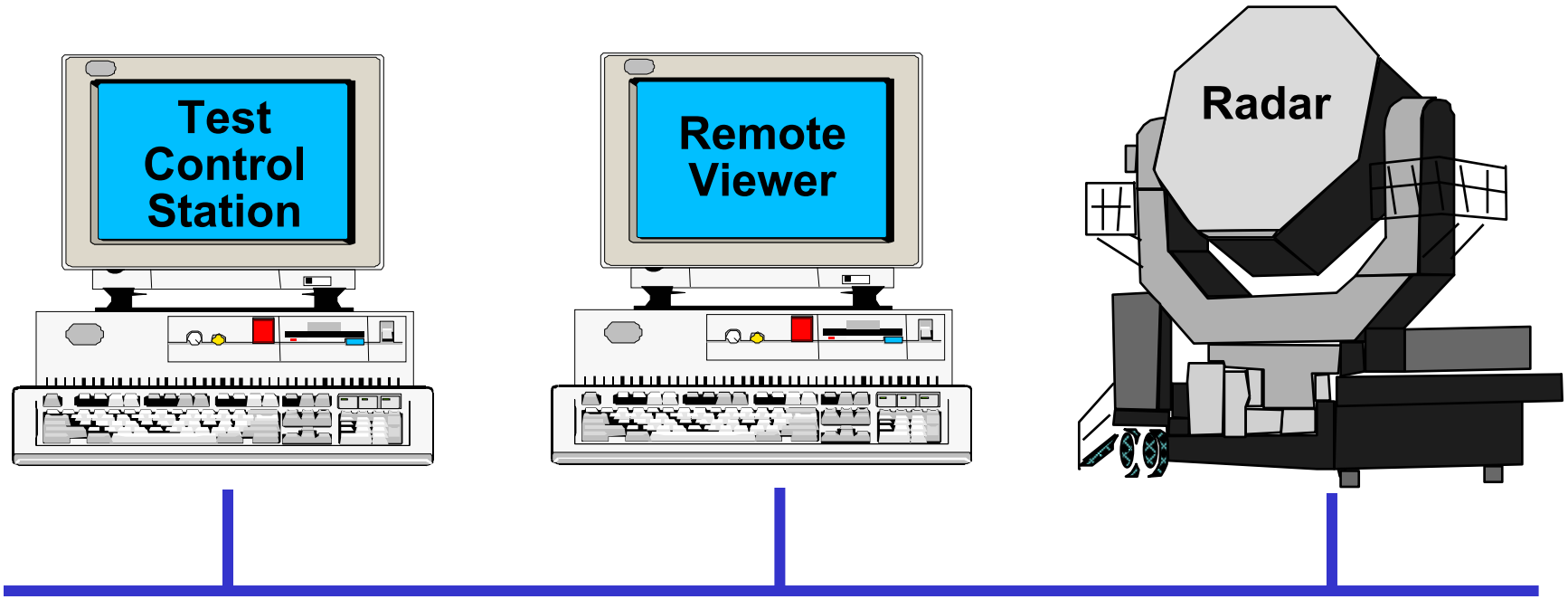


Ways TENA Can Exchange Data

- **TENA presents to the range user a unification of several powerful inter-application communication paradigms**
  - **Publish/Subscribe**
    - Similar in effect to HLA, DIS, or other PDU-based communication systems
    - Each application publishes certain types of information (the publication state) which can be subscribed to by any other application
  - **Remote Method Invocation**
    - Similar to CORBA or Java RMI
    - Each object that is published may have methods that can be remotely invoked by other applications
  - **Messages**
    - Individual messages that can be sent from one application to one or more other applications
  - **Data Streams**
    - Native support for audio, video, and telemetry

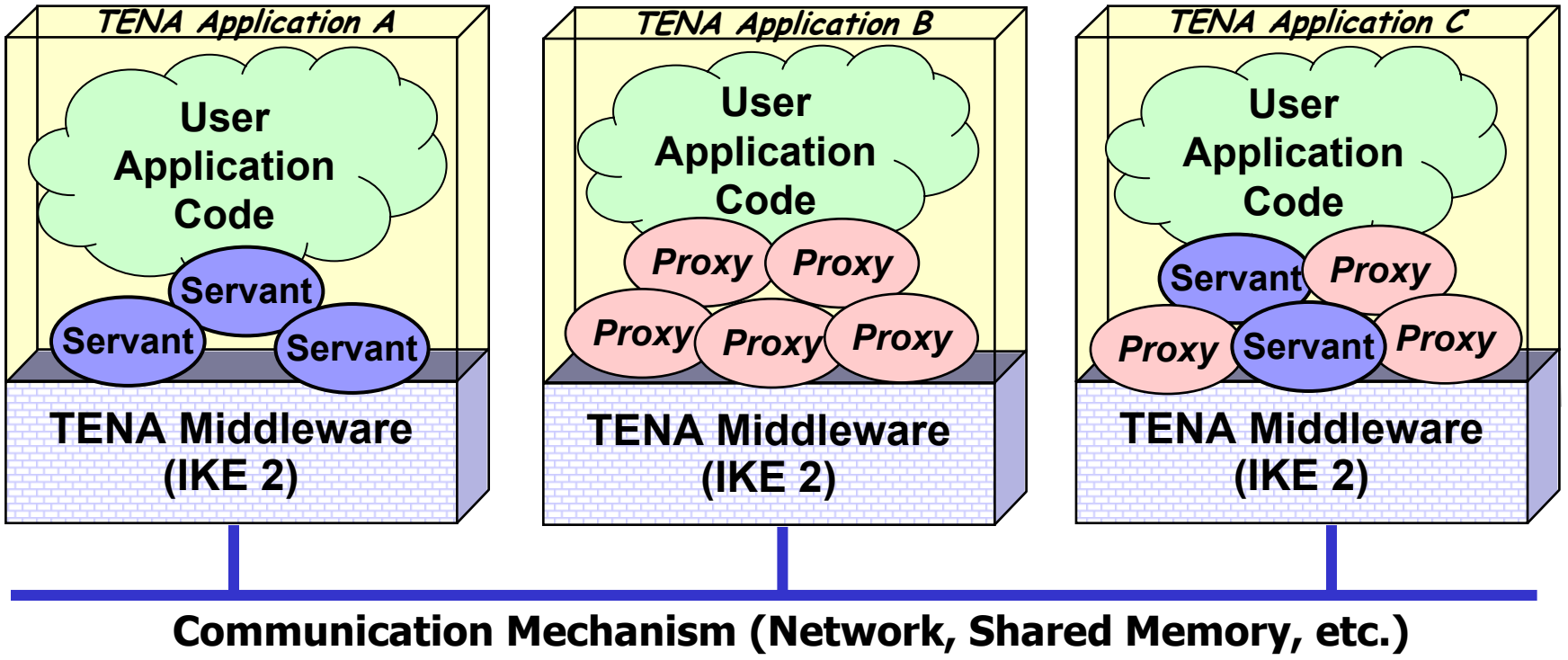
Logical Range
Simple Example

TENA specifies an architecture for range resources participating in logical ranges



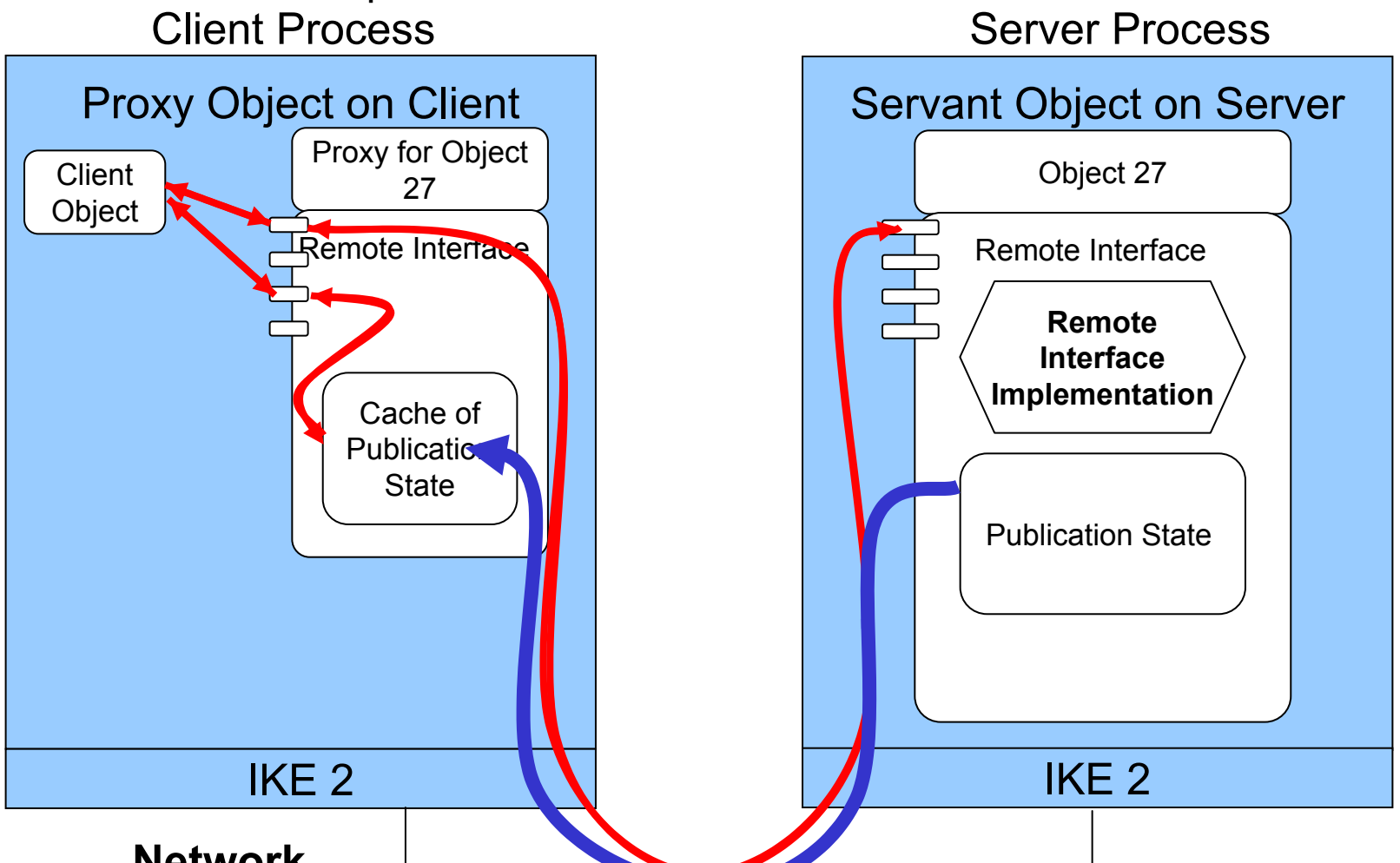
Logical Range Simple Example

- **TENA specifies a peer-to-peer architecture for logical ranges**
  - Applications can be both clients and servers simultaneously
  - In their role as servers, applications serve TENA objects called "servants"
  - In their role as clients, applications obtain "proxies," representing other applications' servants. Only servers can write to their servant objects' publication state
- **The IKE 2 Middleware, the TENA objects, and the user's application code are compiled and linked together**

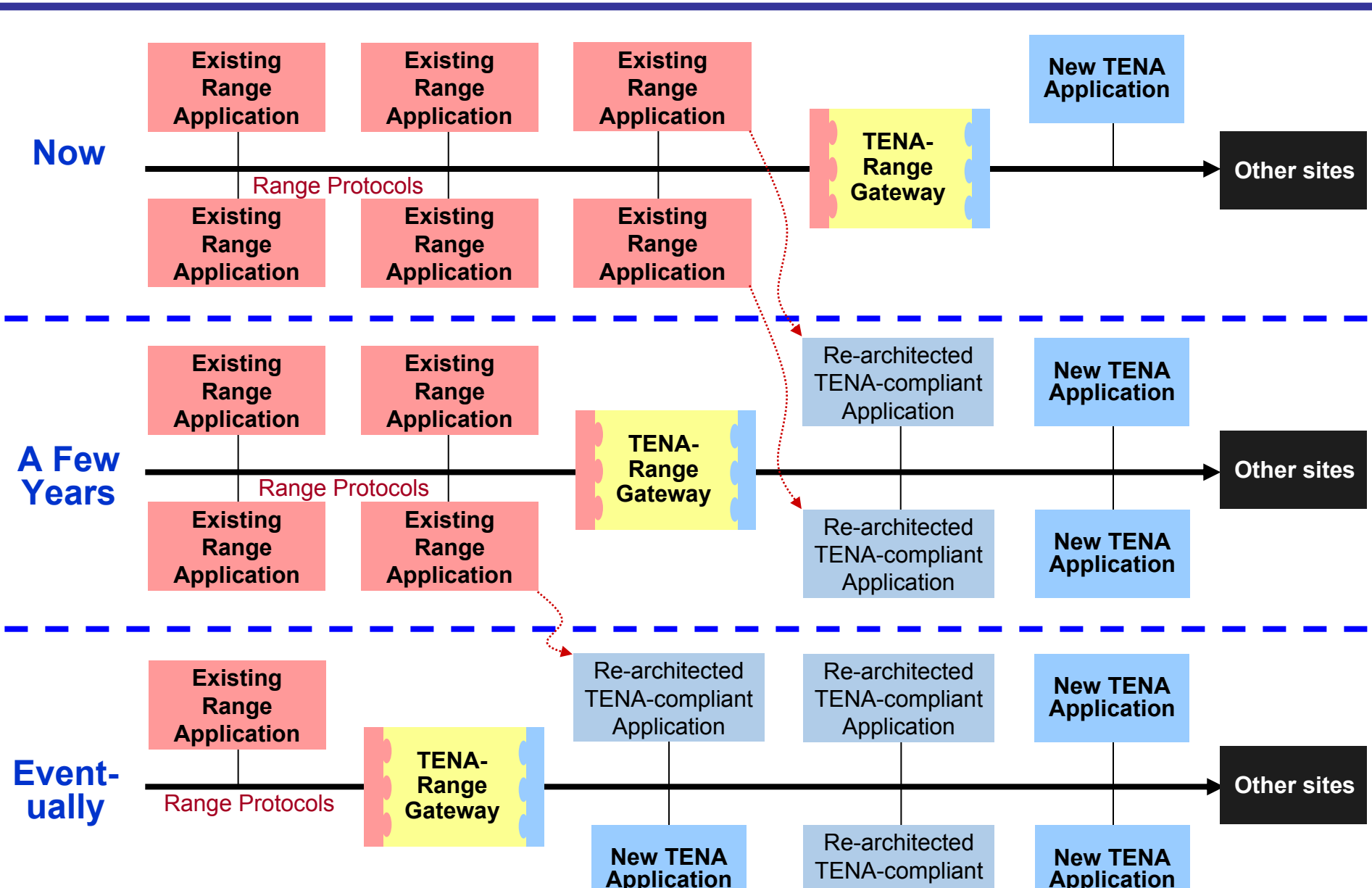


Clients and Proxies; Servers and Servants

- **When objects are distributed across multiple processes or machines**
  - One object is the "real" object – the one with the implementation
  - All the others are "proxies"



Gradual Deployment of TENA



TENA Middleware Platform/Language Support

- **Computer Platform Support**
  - Windows NT 4.0 / 2000 / XP with MSVC++ 6.0sp5
  - Windows NT 4.0 / 2000 / XP with MSVC++ 7.0
  - Linux Red Hat 7.1 with gcc 3.0.3
  - Sun Solaris 8 (SunOS 5.8) with gcc 3.0.3
  - Sun Solaris 8 with SunPro 5.4 compiler
  - SGI IRIX 6.5.12 with gcc 3.0.3 on SGI hardware
  - VxWorks 5.5, Motorola MPC7XXX PowerPC, Tornado 2.2 with gcc 3.0.3
- **Programming Language Support**
  - C++
  - OCX (COM) wrapper (developed by a TENA user)
  - Java

Range Integration in Millennium Challenge 2002 (MC02)

Blue Forces

Ships
Ground forces
Aircraft

Opposing Forces

Aircraft & air targets
Ships

Nellis AFB
TENA Gateway

Land Range/China Lake
TENA Gateway

National Training Center/Ft. Irwin
TENA Gateway

Electronic Counter-measures Range/China Lake
TENA Gateway

Sea Range/Point Mugu
TENA Gateway

US Marines/So. California

Joint Network

Joint Training, Analysis, and Simulation Cente

TENA Gateway

Integrating Software

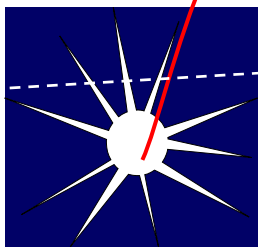
Global Command & Control System

Model & Simulation Feed

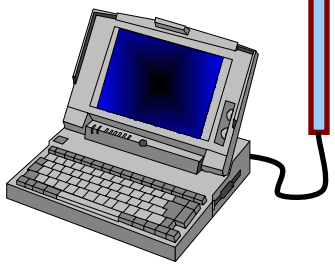
Command, Control, Communications, Computers, Intelligence Feed

Gulf Range Virtual at Sea Training (VAST)/Integrated Maritime Acoustic Scoring and Simulation (IMPASS) Demo

Completed 11/02

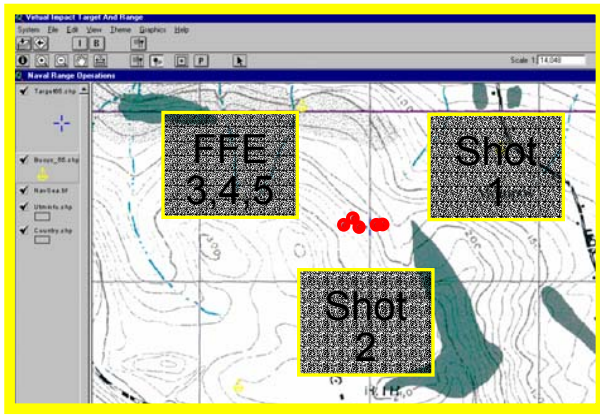


Repeater



Shipboard Processing
Map Rendering
Virtual Target

Acoustic Processing
GPS
Communication Link



VAST/IMPASS Network Connectivity

Eglin Central Control Facility

TENA on NIPRNET

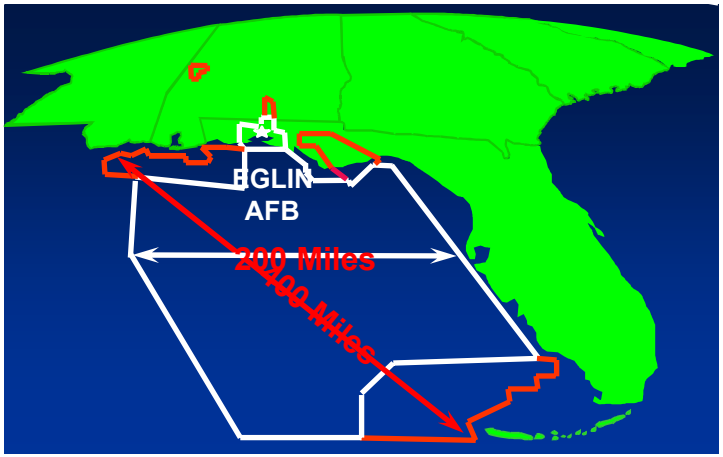
CDSA
Dam Neck, VA

TENA on Fiber

TENA on Microwave

Eglin Range Site A-15

CSS
Panama City, FL

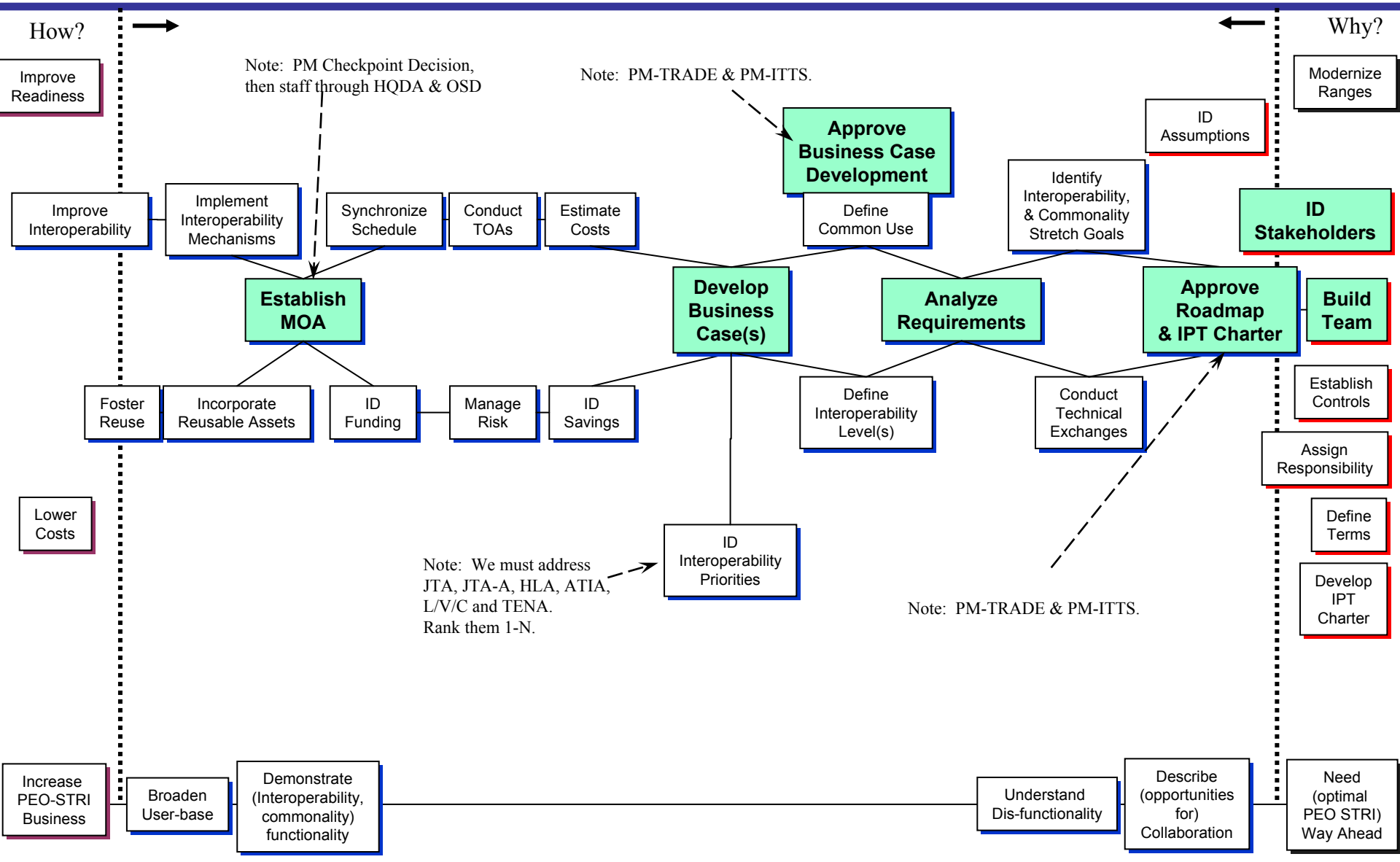


PEO STRI Use of TENA

- VISION - Versatile Information System, Integrated, On-line
- ORTCA - Objective Real-time Casualty Assessment and Instrumentation Suite
- EXCIS - Extensible Software for Test and Evaluation
- DVSD - Digital Video Systems Development
- NGATS - Next Generation Army Target System
- CTIA - Common Training Instrumentation Architecture

The PEO STRI has directed all PEO STRI systems to be TENA compatible where it makes sense

CTIA/TENA Collaboration Function Model



Anticipated DoD Use of TENA

- Joint National Training Capability
- Future Combat Systems – System of Systems Integration Laboratory
- Joint Digitized Engineering Plant – in need of an architecture

Gov't Provided TENA Products/Services

- TENA Middleware Version 4 being released this month
- TENA 2002 Architecture Reference Document
- TENA Middleware Programmer's Guide & Installation Guide
- TENA Definition Language (TDL) Document
- Services of the Government Furnished Web-Based TDL complier for auto code generation
- Middleware Technical Introduction Course for bidders
- Middleware hands-on training for contactor(s) selected
- Web-Based Help Desk available for use during implementation

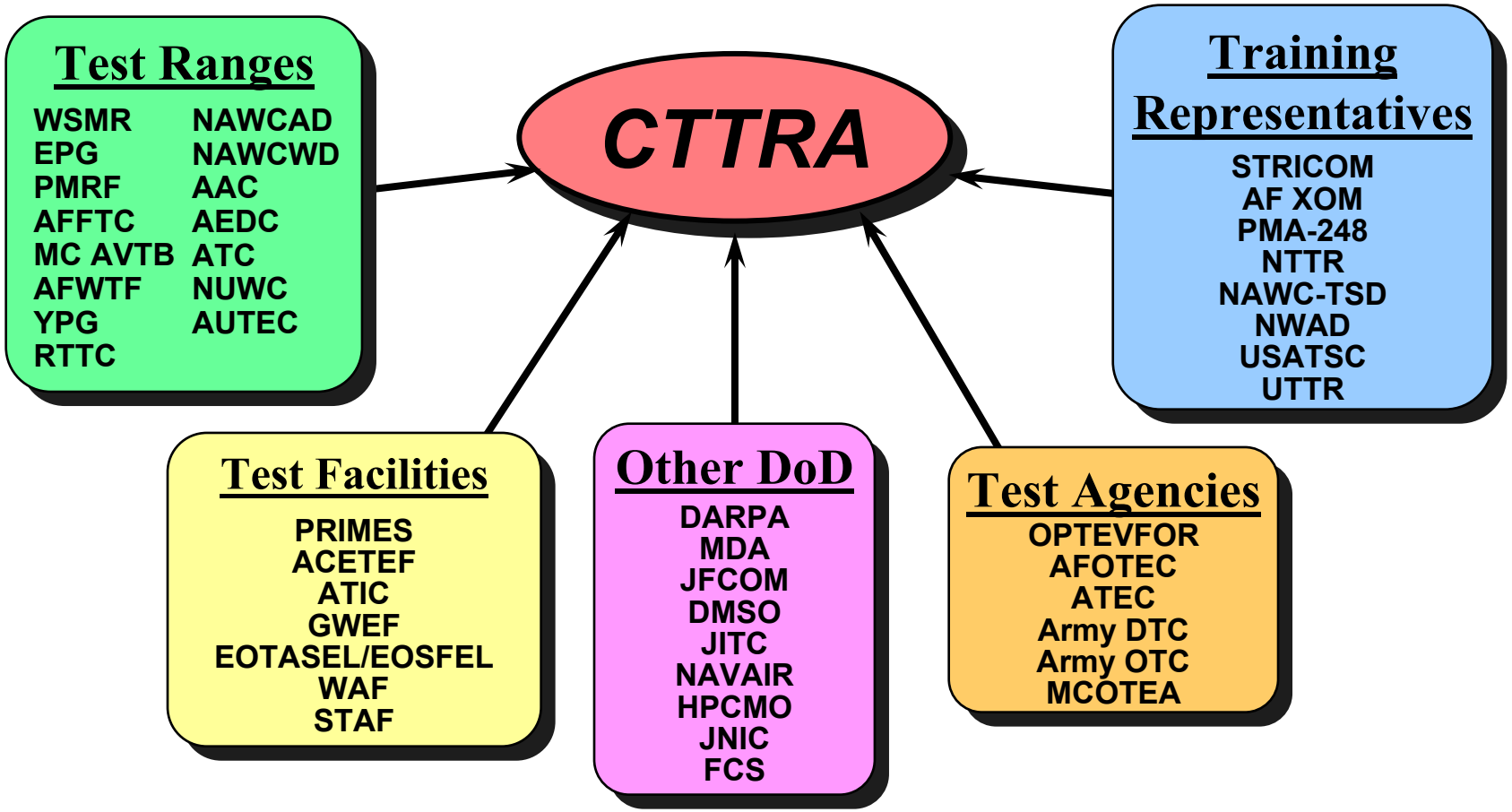
Architecture Management Team (TENA AMT)

- **System Engineers & Technical Leads for the <u>current</u> major stakeholders of TENA**
  - AAC, Eglin AFB FL
  - NUWC, Newport RI
  - NAWC-AD, Pax River MD
  - WSMR, White Sands NM
  - RTTC, Huntsville AL
  - EPG, Fort Huachuca AZ
  - NAWC-WD, China Lake & Point Mugu CA
  - Virtual Proving Ground (VPG)
  - Common Training Instrumentation Architecture (CTIA)
  - PMRF Synthetic Range
  - National Unmanned Underwater Vehicle T&E Center (NUTEC)

Meetings every 4-6 weeks

- **Design Decisions / Trade-offs / Status**
- **TENA Use Cases / Prototype Test Strategies**
- **Technical Exchanges of Lessons Learned**
- **Issues & Concerns Identification, Investigation, & Resolution**

Common Test & Training Range Architecture (CTTRA)



- Systems engineers & software developers in the DoD Range and Facility community (both T&E and Training)
- 14 three-day workshops held (usually every 6-9 months)
- CTTRA XV workshop being planned for July or August 2003

Training Courses Available

- **TENA Technical Overview Course (TOC) – 26 June @ 0800 in de Florez 2040**
  - Designed for the non-programmer
  - Provides basic familiarization on TENA and Logical Ranges
  - Typically 1 day in length (half day & two hour versions are available)
  - Lecture format
- **TENA Technical Introduction Course (TIC)**
  - Designed for the programmer
  - Introduces design concepts to build TENA-compliant applications
  - Typically 1 day in length
  - Lecture format
- **Hands-on Training (HOT)**
  - Designed for the programmer
  - Provides several examples & class exercises to learn the TENA Middleware API
  - Typically 1 week in length
  - Computer classroom format

Acquisition Way-Ahead

- **TENA Middleware Business Opportunities**
  - Longer term contracted sustainment support being developed for late FY04 award
- **TENA Middleware Capabilities - Potential Features Release 5**
  - Requirements being formalized for FY04 enhancements – task may be executed on existing contract
    - Data Streams (video, telemetry, etc.)
    - Fault Tolerance
    - Refine the TENA Application Program Interface (API)
    - Immediate Stateful Distributed Object (SDO) Discovery
    - Vectors of SDOs
    - SDO Update Atomicity
    - Configuration Support
    - Call Back Interface
    - Subscription Filtering
    - One-way Methods

Summary

An Architecture for Ranges, Facilities, and Simulations to Interoperate, to be Reused, to be Composed into greater capabilities

- **A Working Implementation of the Architecture**
  - **TENA Middleware currently works on Windows, Linux, and Sun**
- **A Process to Develop and Expand the Architecture**
  - **CTTRA Workshops, AMT Meetings, and RCC Coordination**
- **A Technical Strategy to Deploy the Architecture**
  - **Gateways provide interim solutions as TENA interfaces**
- **Technical Questions on MC02 and VAST/IMPASS Demos**
  - **Contact Jerry Santos, gsantos@scisol.com**
- Website Access to TENA Documentation
  - **Contact Stephanie Clewer, stephanie.clewer@baesystems.com**
- **TENA Middleware contract will be let this year**
  - **Contact tony_gillooley@peostri.army.mil for contract/programmatic questions**